NATURAL GAS

Make a Bold Impact on Air Quality Today

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Director of Economic Development

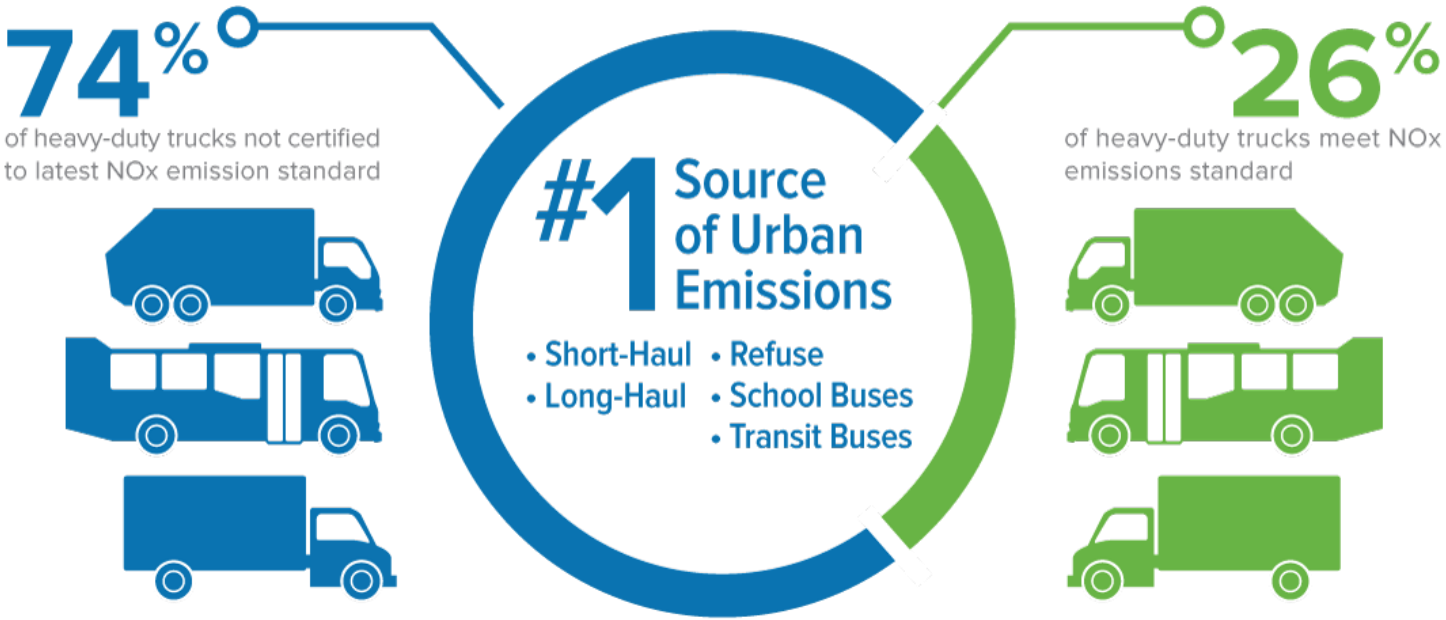
August 1, 2017

spire

The Problem

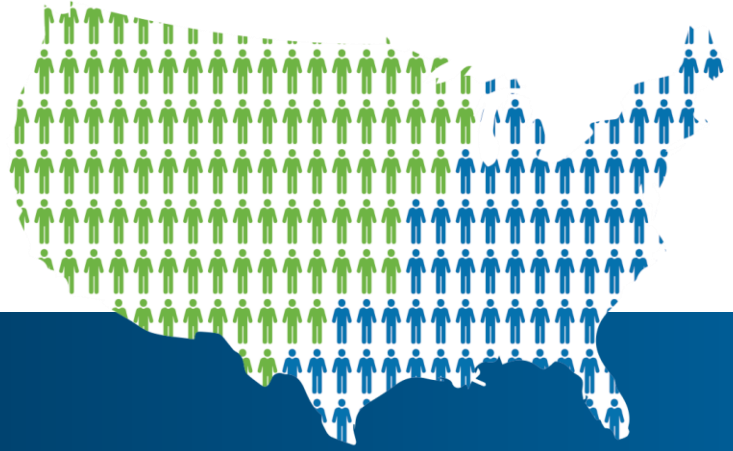
Urban Emissions & Public Health

Urban Emissions: Leading Sources



Source: DTF Analysis on HIS Vehicles in Operation Data, December 2015

166 Million



≈ 50%

of Americans live in areas with air that is unhealthy to breathe

Source: American Lung Association's "State of the Air 2016"

Urban Emissions: Public Health Impacts

Breathing in particle pollution increases the risk of:

- **Asthma**
- **Lung Cancer**
- **Heart Disease**
- **Premature Death**

The Opportunity

Volkswagen Environmental Mitigation Trust Funding

$2.9 Billion Volkswagen Environmental Mitigation Trust

Funding must be used to:

- Address excess nitrogen oxide (NOx) emissions through vehicle purchases/ repowers
- Benefit residents in areas with greatest need (e.g., near urban/industrial areas)
- Replace polluting diesel equipment with cleaner, new or repowered vehicles, including:
  - Local freight trucks
  - Transit buses
  - School buses
  - Shuttle buses
  - Refuse trucks

The Solution

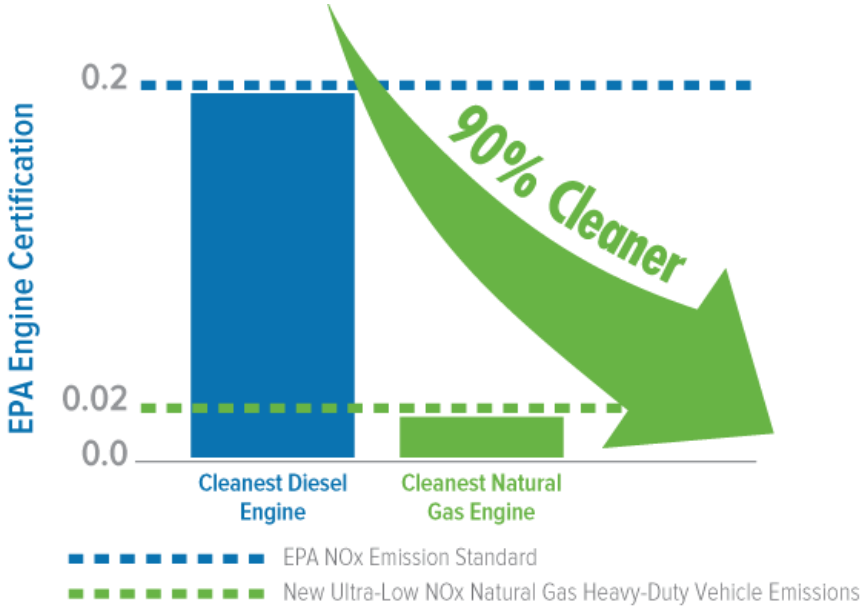
Natural Gas Vehicles: Sustainable, Responsible, Available

Sustainable

NGVs Offer Unmatched Emission Reduction Benefits

The cleanest heavy-duty truck engine in the world is powered by natural gas

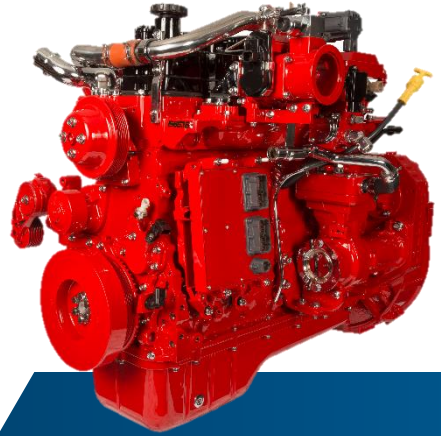
- Certified in 2015 by the U.S. Environmental Protection Agency and California Air Resources Board



The Cummins Westport Ultra-Low NOx engine is certified to a 0.02 g/bhp-hr standard, which is:

- 90% cleaner than the EPA's current NOx standard
- 90% cleaner than the latest available diesel engine

Cummins Westport Optional Near Zero Product Line



ISB6.7 G

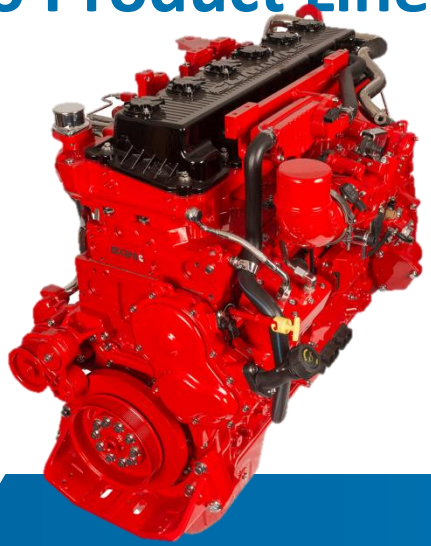
6.7L

- Spark Ignited, SEGR, TWC
- Peak Rating: 240 hp
- 560 lb-ft torque
- 33,000 lb. GVW
- School bus/Shuttle bus/Sweeper/Yard spotter
- **0.1 g/bhp NOx Available Now**

ISL G

8.9L

- Spark Ignited, SEGR, TWC
- Peak Rating: 320 hp
- 1000 lb-ft torque
- 66,000 lb. GVW
- Refuse/Transit/Regional P&D Truck/Mixers
- **NZ Available Now**

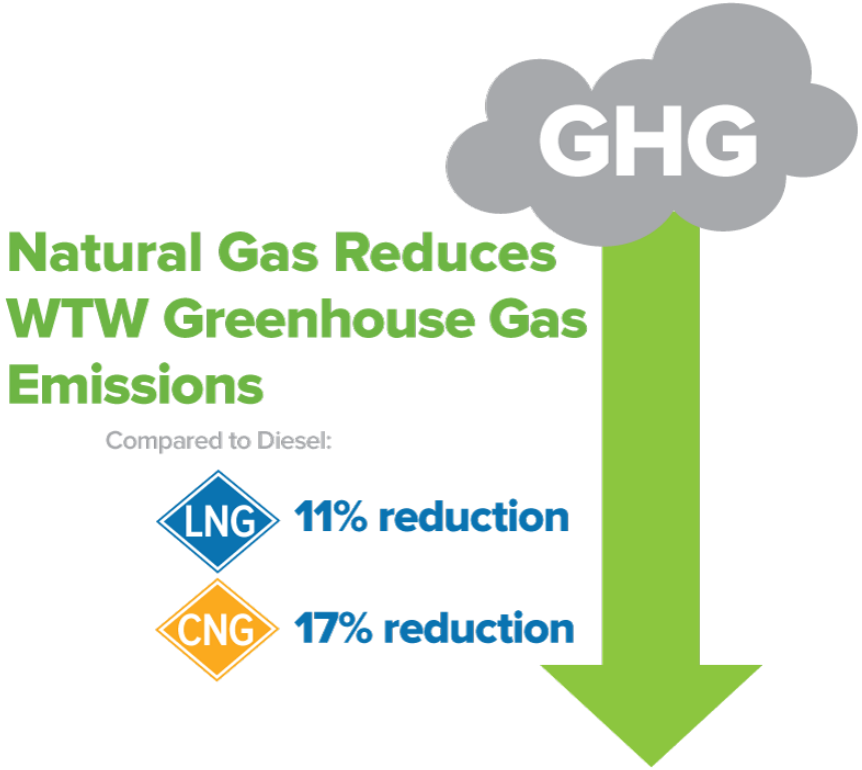


ISX12 G

11.9L

- Spark Ignited, SEGR, TWC
- Peak Rating: 400 hp
- 1450 lb-ft torque
- 80,000 lb. GVW
- Regional Haul Truck/Tractor/Refuse
- **NZ Available Q1 2018**

Fueling with natural gas reduces CO_2 and greenhouse gas emissions



Source: NGVAmerica Emissions Whitepaper based on CARB LCFS
**Numbers compared to diesel emissions (well-to-wheel)*

Responsible

NGVs Maximize the Impact of Available Funding

Short/Regional Haul Truck Comparison – 100% Funding Scenario

Natural Gas

Technology Cost $150,000

NOx Reduced 3,810 lbs

Diesel

Technology Cost $100,000

NOx Reduced 1,858 lbs

Electric

Technology Cost $324,000

NOx Reduced 3,810 lbs

Data Source: NOx emissions are based on low-NOx natural gas engines. EV emissions are the same as natural gas emissions based on the inclusion of power plant emissions, EPA MOVES emission factors for 2017 diesel vehicle, and EPA MOVES for 2007 replacement diesel vehicles. Useful life, cost and mileage vary by applications. Additional details available from NGVA upon request.

Dollar-for-Dollar, NGVs Deliver the Largest & Most Cost-Effective NOx Emissions Reductions

Refuse Comparison – 100% Funding Scenario

Natural Gas

Technology Cost $300,000

NOx Reduced 2,141 lbs

Diesel

Technology Cost $270,000

NOx Reduced 1,417 lbs

Electric

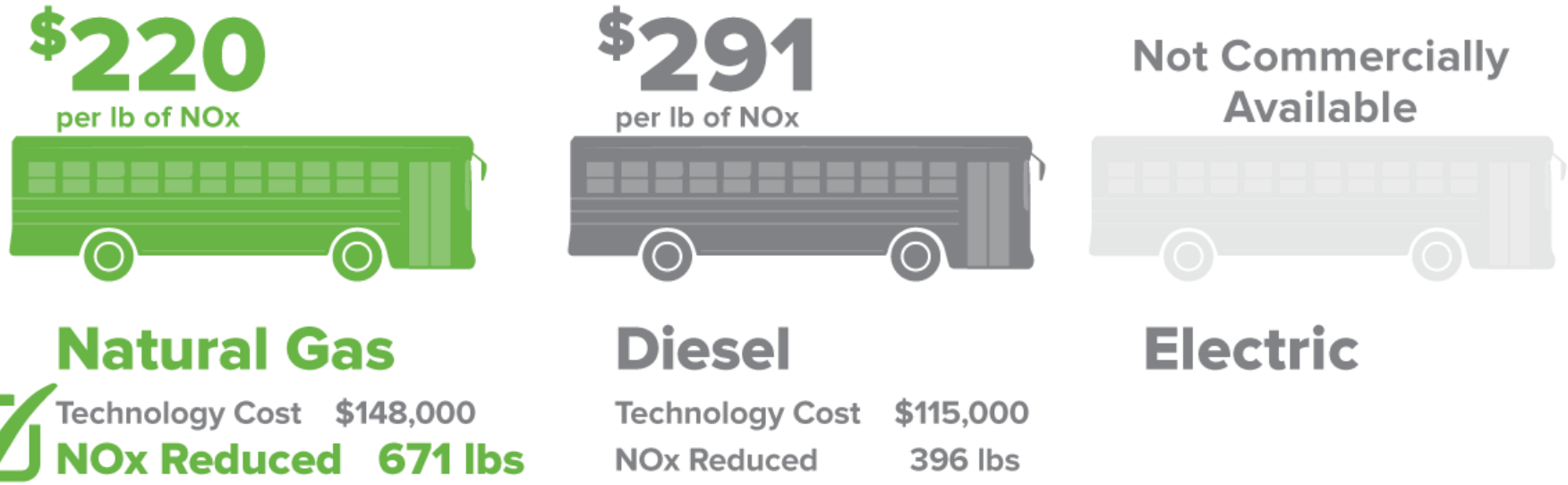
Technology Cost $670,000

NOx Reduced 2,141 lbs

Data Source: NOx emissions are based on low-NOx natural gas engines. EV emissions are the same as natural gas emissions based on the inclusion of power plant emissions, EPA MOVES emission factors for 2017 diesel vehicle, and EPA MOVES for 2007 replacement diesel vehicles. Useful life, cost and mileage vary by applications. Additional details available from NGVA upon request.

Dollar-for-Dollar, NGVs Deliver the Largest & Most Cost-Effective NOx Emissions Reductions

School Bus Comparison – 100% Funding Scenario



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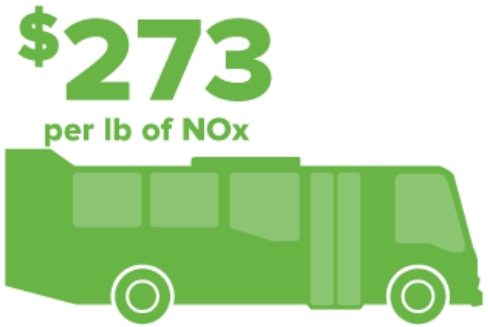
Dollar-for-Dollar, NGVs Deliver the Largest & Most Cost-Effective NOx Emissions Reductions

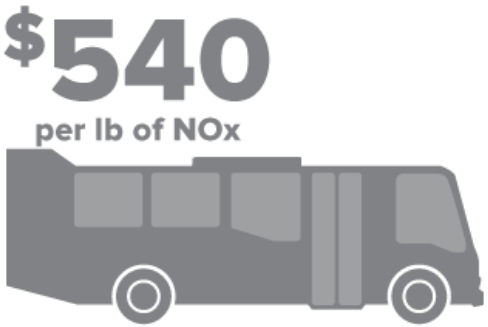
Transit Comparison – 100% Funding Scenario



Natural Gas

Technology Cost $360,000

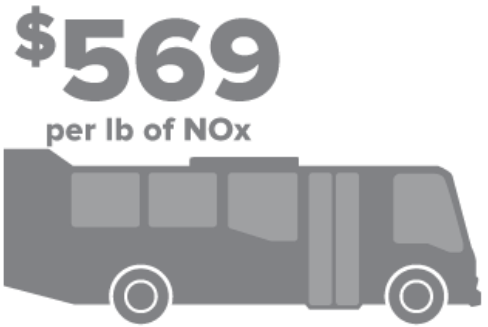
NOx Reduced 1,318 lbs



Diesel

Technology Cost $300,000

NOx Reduced 555 lbs



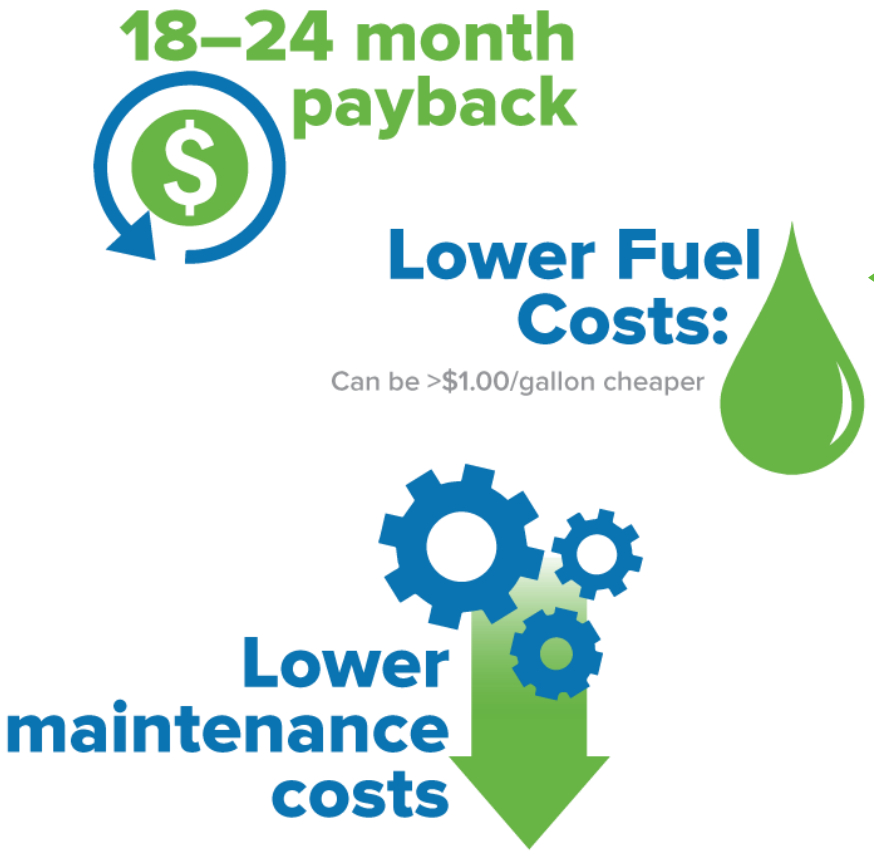
Electric

Technology Cost $750,000

NOx Reduced 1,318 lbs

Data Source: NOx emissions are based on low-NOx natural gas engines. EV emissions are the same as natural gas emissions based on the inclusion of power plant emissions, EPA MOVES emission factors for 2017 diesel vehicle, and EPA MOVES for 2007 replacement diesel vehicles. Useful life, cost and mileage vary by applications. Additional details available from NGVA upon request.

Dollar-for-Dollar, NGVs Deliver the Largest & Most Cost-Effective NOx Emissions Reductions



Depending on range and application, fleets can realize a pay back in as little as 18–24 months due to:

- Lower fuel costs
- Lower maintenance costs

Available

NGVs are Road-Tested &
Commercially Available

Available from OEMs with established sales and service networks

HD Vocational OEMs
- Autocar Truck
- Capacity
- Crane Carrier
- Elgin
- Johnston
- Kalmar
- Mack
- McNeilus
- Peterbilt
- Power Solutions Int'l
- Schwarze
- Tymco

HD OEMs
- Cummins Westport
- Freightliner
- Kenworth
- Mack
- Peterbilt
- Volvo

HD Bus OEMs
- Blue Bird Bus
- DesignLine
- El Dorado
- Gillig
- New Flyer
- New Flyer/NABI Bus
- NOVA Bus
- Motor Coach Industries
- Thomas Built Bus

HD Retrofit/ Repowers
- American Power Group
- Clean Air Power
- Diesel 2 Gas
- Fyda Energy Solutions
- NGV Motori
- Omnitek Engineering

MD Retrofits
- AGA Systems
- Altech-Eco
- Crazy Diamond Performance
- Greenkraft
- Landi Renzo USA/Baytech
- M-Tech Solutions
- Nat-G
- NGV Motori USA
- PowerFuel Conversions
- Roush CleanTech
- STAG
- Westport Fuel Systems
- Zavoli

Fuel Systems
- Agility Fuel Solutions
- Momentum Fuel Technologies
- Mainstay

Class 4-6 Vehicles and NGV Availability

Class Four: 14,001 - 16,000 lbs.

Class Five: 16,001 - 19,500 lbs.

Class Six: 19,501 - 26,000 lbs.

AVAILABLE NOW

Class 4-6 Vehicles and NGV Availability

Class 7-8 Vehicles and NGV Availability

AVAILABLE NOW

Class 7-8 Vehicles and NGV Availability

AVAILABLE NOW

School/Transit Bus and NGV Availability

AVAILABLE NOW

Refuse Vehicles and NGV Availability

AVAILABLE NOW

NGVs are road-tested, proven technologies that are operating worldwide

Data Source: NGVGlobal, December 2016

Several high-profile fleet operators use NGVs in daily operations

AVAILABLE NOW

Advantages of Natural Gas as a Transportation Fuel

Abundant Domestic Availability,
Widespread Distribution Infrastructure,
Low Cost and Price Stability

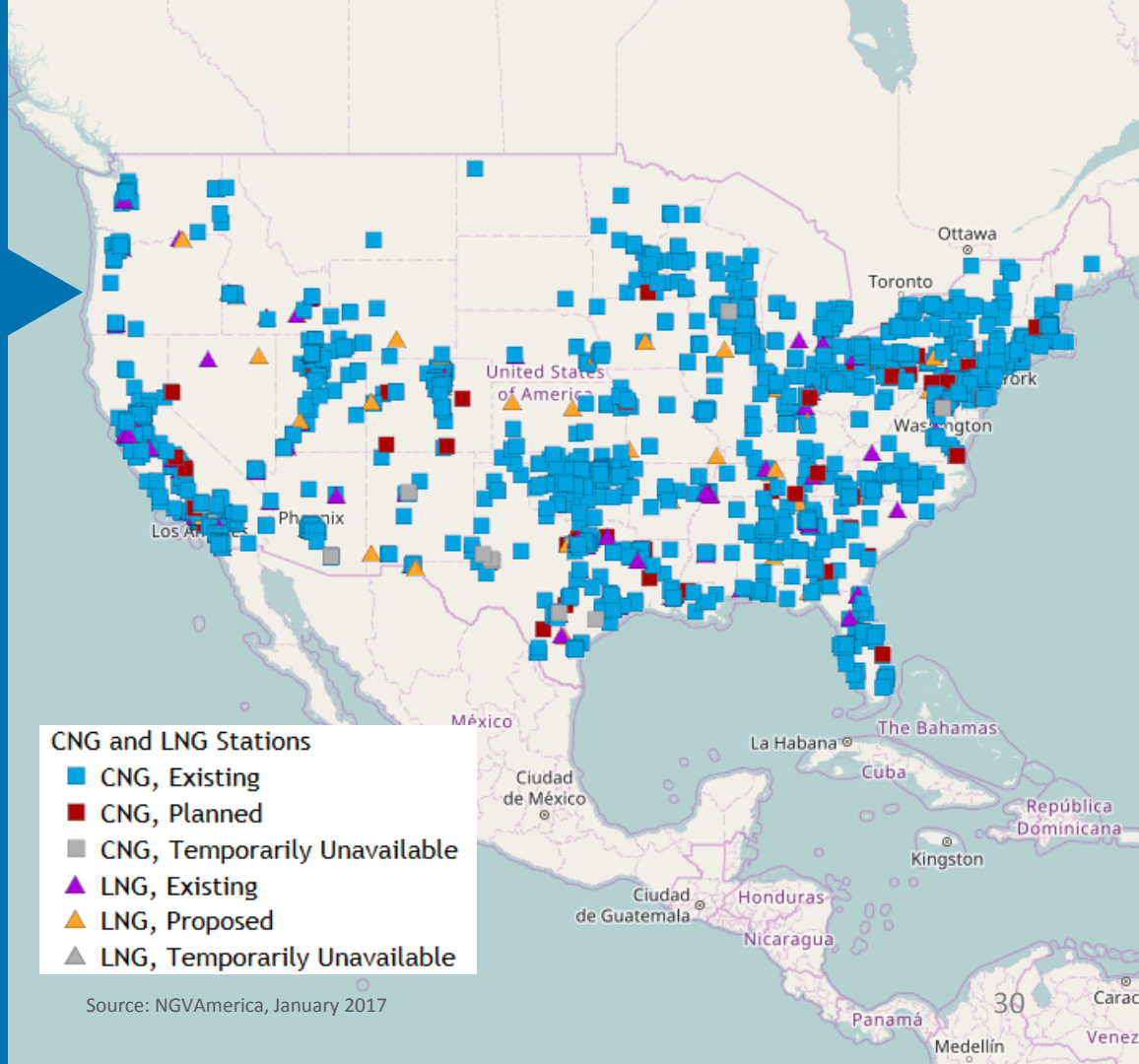
North America has an abundant domestic supply of conventional natural gas

Source: U.S. Energy Information Administration, January 2017

Natural gas fuel station infrastructure is continually expanding

≈2,000 Natural Gas Stations

- More than doubled past 5 years
- 10-12+ new stations per month



Source: NGVAmerica, January 2017

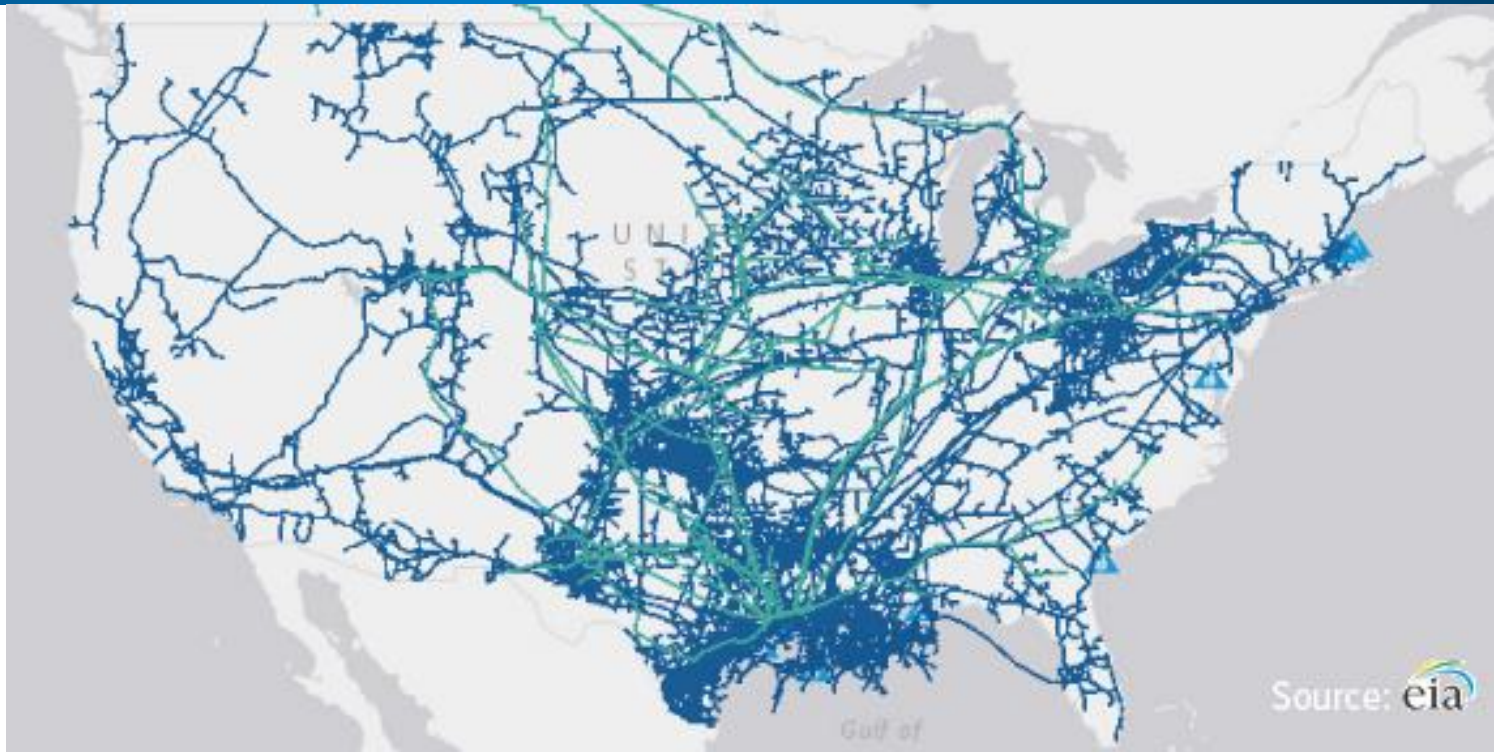
Diverse network of natural gas station developers

- Natural gas retail fuel sellers
- LDCs
- C-Stores
- Truck Stops
- Grocery/Warehouse stores
- Leasing companies
- Gas exploration & production
- Midstream pipeline

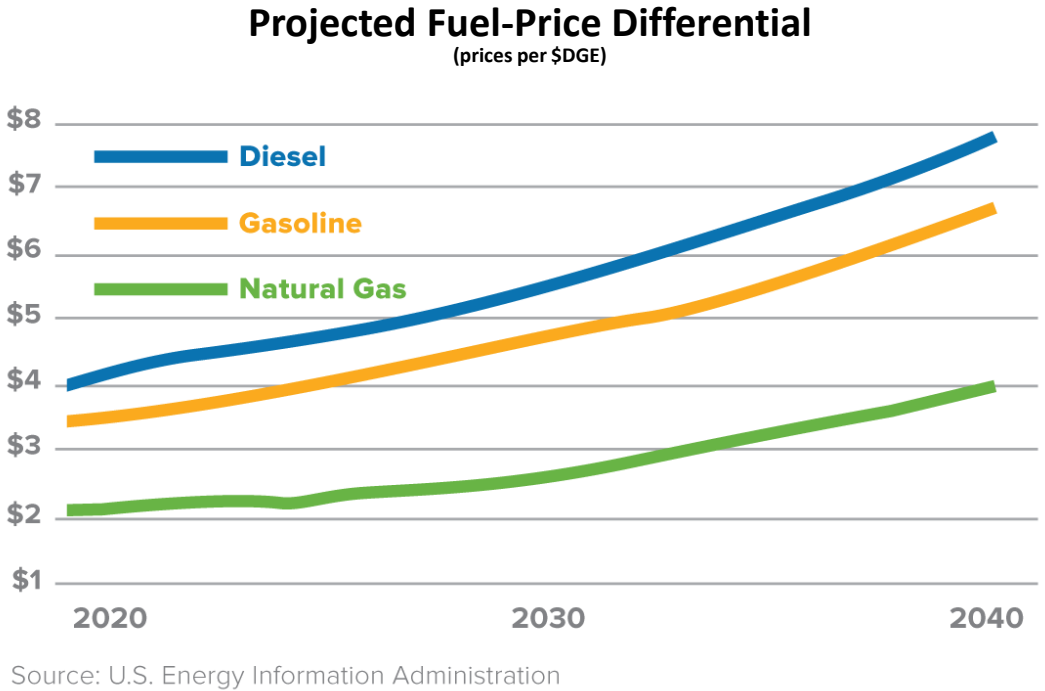
The U.S. natural gas pipeline system is well poised to support a national network of CNG and LNG fueling stations

2.5+ million

miles of U.S. pipeline infrastructure



Natural Gas Provides Long-Term Fuel Cost Savings

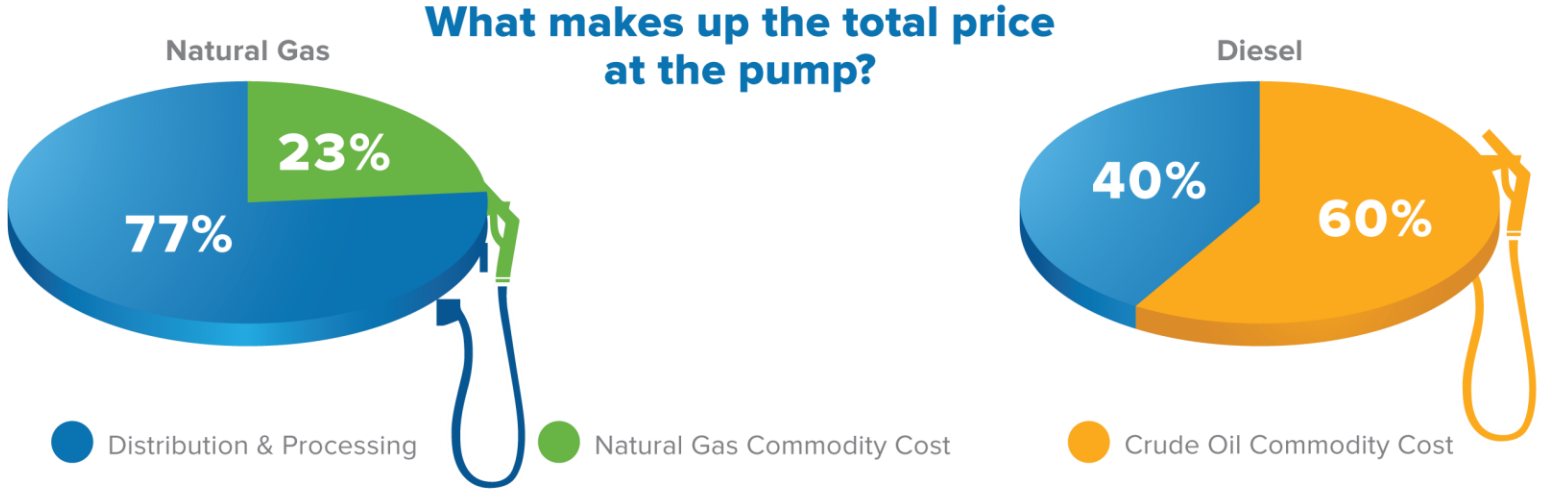


Source: U.S. Energy Information Administration

Natural Gas vs. Oil:

- 3:1 price advantage over oil on a Btu basis
- Pump prices $0.75 to $1 lower than diesel

Natural Gas Provides Fuel Price Stability



Natural Gas:

- Decades of affordable domestic reserves
- Natural gas sourced from North America
- Commodity cost makes up 23% of sales price

Diesel:

- History of volatile price swings
- Crude oil sourced fuel from high-conflict regions
- Commodity cost makes up 60% of sales price

Natural gas vehicles are up to 3x quieter than their diesel counterparts and significantly reduce noise pollution in the local community.

Conclusion: NGVs are the Best Value for State VW Funds

Recommendations

- ✓ Fund **alternative** fuel vehicle projects that maximize NOx reductions for the funds spent for both public and private fleets
- ✓ Provide greater funding for MD & HD vehicles powered or repowered by engines that deliver NOx reductions **greater** than current EPA standards
- ✓ Target funding for technologies that have demonstrated **lower in-use** emissions
- ✓ Prioritize funding for projects with commercially **available** products
- ✓ Stay flexible in plans and **leverage private investment** to stretch dollars and get more **alternative** vehicles on the road

NATURAL GAS

Thank You
How can we help?

Jim Hearing
Director of Economic Development

August 1, 2017

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